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Preface

Research on the Eastern Tropical Pacific has always been a close cooperation between fishery scientists, biologists and physical oceanographers. Web Chapman and Benny Schaefer had the foresight to recognize that the success of fisheries depends largely on the understanding of the life cycles as well as of the environments of the fish. This viewpoint resulted in the establishment of the Inter-American Tropical Tuna Commission, the Tuna Oceanographic Research Program at Scripps Institution of Oceanography and the Tuna Research Laboratory of the Bureau of Commercial Fisheries in La Jolla, all well-supported research efforts in this region.

My coming to Scripps was not accidental. I had met Roger Revelle for the first time in 1955 in Tokyo, at a UNESCO conference on Marine Sciences. At the time, I was working in Indonesia, analyzing the oceanography of the Southeast Asian Waters. I met Roger Revelle again during the Pacific Science Congress in Bangkok in 1957, where I reported on upwelling in the eastern part of the Indonesian waters and outlined for the first time the throughflow of water from the Pacific to the Indian Ocean. I had moved on to Australia, when one day a message came from Scripps offering me a position. I accepted immediately without even knowing precisely what I would be doing there. Which young oceanographer could refuse such an offer? Before going to California, I attended the Pacific Science Congress in Honolulu in August 1961, where I did meet several of the scientists with whom I was going to be working at Scripps.

When I arrived in December 1961 at Scripps I was assigned to the Tuna Research Program, which was then under the direction of Maurice Blackburn. My task was to study the physical oceanography of the Eastern Tropical Pacific, with the hope that this work might provide valuable information for the fisheries in that region. I was given an office in an old cottage called T28; it had an ocean view and had previously been occupied by John Knauss. In my cottage were also Warren Wooster and Bert Bennett, and in nearby buildings worked Joe Reid and Gunnar Roden.

Just before leaving Australia my monograph on the physical oceanography of the Southeast Asian waters went to the press. The monograph combined the existing knowledge about these waters into a comprehensive description of the circulation and water masses (Wyrtki, 1961). In working on this project, I came to realize that combining information from different sources, such as surface current charts, dynamic calculations, sea level observations and water structure, leads to a much more detailed and complete picture of the circulation of a region than any one set of observations alone.

This experience motivated me to make a similar analysis of the Eastern Tropical Pacific. Given my taste for existing data, I was delighted when upon my arrival Warren Wooster handed me the unused data from the STEP ONE expedition off Peru. Analyzing the upwelling off Peru with these data, I found that subsurface converging flows from both the north and the south supply the upwelled water, and that the Peru Current has a relatively weak flow along the coast and a much broader flow offshore feeding the South Equatorial Current (Wyrtki, 1963). This was before computers became commonly available, and the dynamics had to be tediously calculated on a mechanical calculator and the results recorded with pencil.

Bert Bennett and I used the John Knauss' current measurements of the Equatorial Undercurrent to show that the undercurrent is first accelerated by a pressure gradient from west to east and then slowed upon arrival at the Galapagos Islands by a reversal of this gradient (Wyrtki and Bennett, 1963). There was a very pleasant cooperation among scientists in the Tuna Research Program.

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As I had done in Indonesia, I constructed monthly maps of the surface circulation in the Eastern Tropical Pacific from surface current data (Wyrtki, 1964a). Such maps illustrate the changing pattern of the circulation during the year, and I consider such maps to be the starting point for understanding the dynamics of a region.

Since the structure of the thermocline is intimately related not only to currents but also to fishing grounds, I used the existing temperature profiles for the region to document the thermal structure and its annual variations. This effort became the cornerstone of a description of the oceanography for the entire Eastern Tropical Pacific (Wyrtki, 1964b). Realizing that data were rather sparse over wide areas and insufficient for constructing the maps from the basic data, I followed a different path and analyzed the annual variation of the thermal structure by lumping the data horizontally in selected areas. Once an annual cycle was established, it was easy to follow the horizontal changes of that cycle and use it to construct maps of such properties as thickness of the mixed layer, maximum temperature gradient, and main thermocline depth. This method required less data, but much more imagination. All of this data processing had to be done by plotting dots by hand on graph paper.

The importance of the Costa Rica Dome for the Tuna fishery led me to investigate its dynamics and to show that the shallow position of the thermocline in the center of the dome was due to the turning of the Equatorial Countercurrent (Wyrtki, 1964c). I greatly underestimated the amount of upwelling in the dome, however, because I believed a stronger upwelling would make the mixed layer disappear.

Jacob Bjerknes, who was also collaborating on the Tuna program, was interested in the atmospheric circulation over the equatorial Pacific and its interannual variations related to El Niño. From time to time he came down from UCLA to visit colleagues at Scripps and on these occasions we talked about El Niño. These talks stimulated my interest in El Niño and inspired my later work on this important climate phenomenon (Wyrtki, 1975, 1985).

At that time, masses of climatological data became available on magnetic tape from data centers. I used them to start a study of the heat exchange between ocean and atmosphere in the Eastern Tropical Pacific. This was my first attempt to use the power of computing for my research, but I never learned to program because I always had the help of excellent programmers. The data came from ship weather reports and contained many errors, and we had to spend much time cleaning it up. I liked to work with sparse and at times inadequate data because they offered the opportunity to discover something new. The study started with an analysis of the heat exchange in the Eastern Tropical Pacific but was extended to the entire North and Equatorial Pacific after I left for Hawaii (Wyrtki, 1965a,b).

I wanted to combine the results of the previous studies and write something similar to the report on the Indonesian waters, but by that time I had already left for Hawaii. Nonetheless with slight pushing from Maurice Blackburn and Benny Schaefer I wrote two summary papers, which have been extensively used in the following decades (Wyrtki, 1966, 1967). I do not recall why there are two similar papers, but I think that the first was invited. I tried to give a comprehensive picture of the water transports in the region, because I had always been puzzled by how the huge South Equatorial Current is fed by the weak Peru Current until I realized it was the termination of the undercurrent and equatorial upwelling, which allowed its intensification.

Since those early days, new technologies for data collection and for computers have emerged, making vast new data sets available to researchers. Satellites give global coverage of winds, temperature, and sea surface topography. Drifting buoys and moorings allow the tracking of currents and of the thermal structure. Data are available almost instantaneously and computers process them rapidly. No wonder that these changes have yielded new insights and better understanding. The new observational methods have also allowed analyses of short and long-term variability, something that was not possible in the 1960s.

In the sciences, it is not uncommon that a given research topic reaches a saturation point and interest in it fades. With time, however, understanding advances so much that the re-examination of an old subject is worthwhile, and this volume is certainly evidence for the usefulness of such a revisit.

It is of course gratifying to know that after so many years one's research is still considered as a kind of starting point for further studies, and I am most thankful to the scientists who dedicated this volume to me.

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